lunar perturbations only converge by the same amount for each power of the disturbing force of the Sun, it is necessary to take into consideration the fourth power of the disturbing force of the Sun together with the first power of the disturbing force of *Jupiter*. After satisfying myself that both inequalities possessed a sensible value in comparison with the other inequalities arising from the action of the planets, the task of completely determining the value of these terms was postponed until the completion of my new Tables of the general development of the higher powers of the disturbing forces in the lunar theory.

These Tables have been now finished sufficiently to enable them being used to compute the value of these two inequalities, a work now of comparatively small trouble and difficulty; and the algebraical coefficients obtained, which are lengthy, have been reduced to numbers. The results are—

$$\delta r = -0''{\cdot}493 \cos\{(2-2m_1-c)nt+f-2f_1+\mathrm{A}\} + 0''{\cdot}001 \cos\{(2-2m_1-2c)nt-2f_1+2\mathrm{A}\}.$$

$$\delta v = -0''{\cdot}990 \sin\{(2-2m_1-c)nt+f-2f_1+\mathrm{A}\} + 1''{\cdot}513 \sin\{(2-2m_1-2c)nt-2f_1+2\mathrm{A}\}.$$

It is of course only in the longitude that these terms could become sensible. The labour in properly computing the value of these terms is shown by the fact that it cannot properly be done unless over twenty similar terms have had their values previously ascertained.

These two new terms derive additional interest from the fact that they are the first terms derived from the second portion of the disturbing force of the planets which have been found to possess sensible coefficients. They, moreover, have considerably larger values than any other inequalities due to *Jupiter*.

Corrections to the Nautical Almanac Places of the Moon for Longitude Observations in connection with the Transit of Venus 1874. By Captain G. L. Tupman.

(*Communicated by the Astronomer Royal.*)

These corrections have been deduced entirely from observations at places which have been connected by galvanic signals with the Royal Observatory, Greenwich, for longitude, and where both limbs of the Moon were equally observed, viz.:—

1° of both elements at Greenwich, with the Transit-Circle and Altazimuth, between 1874, Sept. 15, and 1875, Feb. 23.

2° of both elements at Paris, between 1874, Sept. 14, and 1875, Feb. 22, including those made with the Gambey instruments, published in *Comptes Rendus* 1875, May 24.

3° of Right Ascension at Königsberg between 1874, Sept. 19, and 1875, Feb. 26, published in the *Astronomische Nachrichten*, Nos. 2020 and 2050.

4° of Right Ascension at Strasburg between 1874, Oct. 23, and 1875, Feb. 25, *Astronomische Nachrichten*, No. 2050.

5° of North Polar Distance at the Radcliffe Observatory, Oxford, between 1874, Sept. 18, and 1875, Jan. 21.†

The published errors of the tabular R.A. at Königsberg differ considerably from the errors obtained at the other observatories, and the discordance appears to vary with the Moon's declination, as if the instrumental corrections were imperfect. As, however, the observed R.A.s of the stars observed near the Moon are also given, new errors of the tabular R.A. were determined in the following manner :—

The apparent R.A. of every star at transit over the Meridian of Königsberg, founded on a mean R.A. derived from the Greenwich Catalogue for 1864, or, in default, 1860, was computed and compared with the observed R.A. A correction for the day was thus obtained from each star, and the mean from all the stars was applied to the observed R.A. of the Moon's limb.

The tabular R.A. of the limb was then interpolated with fourth differences from the section "Moon culminating Stars" in the *Nautical Almanac*, adopting for the longitude of Königsberg Observatory $1^h\ 21^m\ 59^s{\cdot}32$, which results from galvanic signals, viz. :—

	m	s	
Brussels east of Greenwich	17	28·90	(*Royal Obs. MSS.*)
Berlin east of Brussels	36	6·42	(*Astr. Nach.* XLV. 225).
Königsberg east of Berlin	28	24·00	(*Astr. Nach.* LVII. 350).

The difference between the interpolated R.A. and the observed R.A. corrected as described above was taken as the error of the tables.

A similar comparison of the observed and tabular R.A. of stars observed near the Moon at Strasburg showed no systematic discordances ; the published corrections were therefore adopted, as were also the Paris corrections.

The mean correction for each day, allowing half weight to the Greenwich Altazimuth and the Königsberg observations, was then plotted off on charts of ruled squares, treating the R.A. and N.P.D. separately, and a free curve drawn through all the points. The adopted position of this curve among the points was submitted to several persons for criticism, and is believed to give the corrections as accurately as the observations admit.

Professor Newcomb's corrections were then plotted off on the same charts, and as the "observation-curve" was weak at the beginning and end of each lunation, it was made parallel to Professor Newcomb's.

The corrections taken from this modified portion of the curve are denoted by an asterisk (*).

† The Washington Observations had not been received at Greenwich when the corrections were determined ; they would have been a valuable addition.

Corrections of the Moon's Tabular Place in the Nautical Almanac.

Day of the Month.	1874 September. R.A. s	N.P.D. "	October. R.A. s	N.P.D. "	November. R.A. s	N.P.D. "	December. R.A. s	N.P.D. "	1875 January. R.A. s	N.P.D. "	February. R.A. s	N.P.D. "
7											−·30	+3·5
8											−·30	+4·2
9											−·31	+4·5
10									−·40*	0·0	−·35	+4·8
11									−·42*	+1·3	−·37	+4·8
12					−·43*	+2·0	−·34*	+2·0	−·44*	+2·5	−·41	+4·5
13	−·37		−·27*	−3·0	−·42*	+2·7	−·35*	+3·0	−·45*	+3·4	−·45	+3·5
14	−·38	−1·0	−·28*	−2·5	−·40*	+3·1	−·36*	+3·8	−·47	+3·8	−·50	+2·3
15	−·40	−0·3	−·30	−2·0	−·37*	+3·4	−·38*	+4·5	−·48	+4·0	−·55	+1·0
16	−·41	0·0	−·35	−1·3	−·35	+3·6	−·40	+5·0	−·50	+3·6	−·57	−0·6
17	−·42	+0·6	−·38	−0·4	−·32	+3·6	−·45	+5·0	−·52	+2·7	−·60	−2·6
18	−·43	+1·3	−·41	+0·7	−·35	+3·6	−·48	+4·5	−·54	+1·4	−·58	−3·6
19	−·44	+1·7	−·44	+2·0	−·37	+3·5	−·51	+3·4	−·56	−0·6	−·55	−4·2
20	−·45	+2·3	−·46	+3·5	−·44	+3·5	−·55	+1·7	−·59	−2·1	−·53	−4·2
21	−·47	+2·8	−·50	+5·0	−·51	+3·3	−·59	0·0	−·62	−3·2	−·48	−3·8
22	−·49	+3·5	−·54	+5·7	−·59	+3·0	−·64	−1·5	−·65	−3·5	−·44	−3·2
23	−·52	+4·1	−·58	+6·0	−·67	+2·6	−·69	−3·0	−·66	−3·6	−·41	−2·0
24	−·56	+5·0	−·65	+5·7	−·75	+2·0	−·74	−4·4	−·66	−3·5	−·39	

Day of the Month.	1874 September. R.A. s	N.P.D. ″	October. R.A. s	N.P.D. ″	November. R.A. s	N.P.D. ″	December. R.A. s	N.P.D. ″	1875 January. R.A. s	N.P.D. ″	February. R.A. s	N.P.D. ″
25	−·61	+5·8	−·75	+5·2	−·85	+1·2	−·75*	−5·3	−·65	−3·3	−·36	
26	−·69	+6·2	−·80	+4·1	−·92	0·0	−·76*	−6·1	−·62	−3·0	−·35	
27	−·77	+5·7	−·80	−2·8	−·91	−1·0	−·73*	−6·7	−·57	−2·6	−·35	
28	−·83	+4·9	−·78	−1·3	−·80	−1·6	−·66*	−7·1	−·53	−2·2		
29	−·83	+4·0	−·76	−0·4	−·66	−2·3	−·60*	−7·1	−·47	−1·7		
30	−·80	+3·0	−·74	−1·6	−·60	−2·8	−·55*	−7·0	−·42	−1·4		
31			−·70	−2·6			−·51*	−6·6	−·40*	−1·0		

	October.		November.		December.		January.		February.	
1	−·75	+1·7	−·66	−3·5	−·55	−3·0	−·48*	−6·0	−·38*	−0·5
2	−·70	+0·6	−·63	−4·1	−·52	−3·1	−·45*	−5·3	−·36*	0·0
3	−·66	−0·7	−·59	−4·4	−·51	−3·0	−·43*	−4·4	−·36*	+0·5
4	−·63	−2·1	−·55	−4·5	−·50	−2·8	−·40*		−·36*	+1·0
5	−·59	−3·2	−·52*	−4·3	−·50*	−2·5				
6	−·56	−3·6	−·48*	−4·0	−·50*	−2·0				
7	−·53*	−4·0								
8	−·51*	−4·0								

The differences between the individual observations and the curve are shown below, the sign + signifying that the observed R.A. and N.P.D. are greater than the adopted.

	Right Ascension.					North Polar Distance.			
1874	Greenwich Transit Circle. s	Greenwich Altazimuth. s	Paris. s	Königsberg. s	Strasburg. s	Greenwich Transit Circle. "	Greenwich Altazimuth. "	Paris. "	Oxford. "
Sept. 14			−·08						
,, 15		+·30	−·11				−3·3		
,, 18		+·40	−·18				+1·5	−2·1	+1·8
,, 19		+·35	(+·05 / −·19)	−·08			0·0	+4·2	
,, 20				−·06					
,, 21	+·03	+·19		+·01		−0·2	+0·7	−3·8	+1·5
,, 22	+·02	+·18		−·07		−0·6	−3·0		+2·0
,, 23		−·15		−·10			−1·9		−0·6
,, 24		−·02	−·14				+2·1	−2·0	
,, 25	−·02	+·20	+·06			−1·0	+4·4	−1·3	+0·2
,, 26	+·07	·00	+·05	−·11		−0·9	+0·2	+1·0	
,, 27	+·11	−·34				−0·9	+1·3		
,, 28	+·17	−·30				−1·5	+0·5		
,, 29		−·04		+·04			−0·8		
Oct. 1		−·25					+1·9		
,, 2		−·07					+2·0		
,, 3		+·28					−2·1		

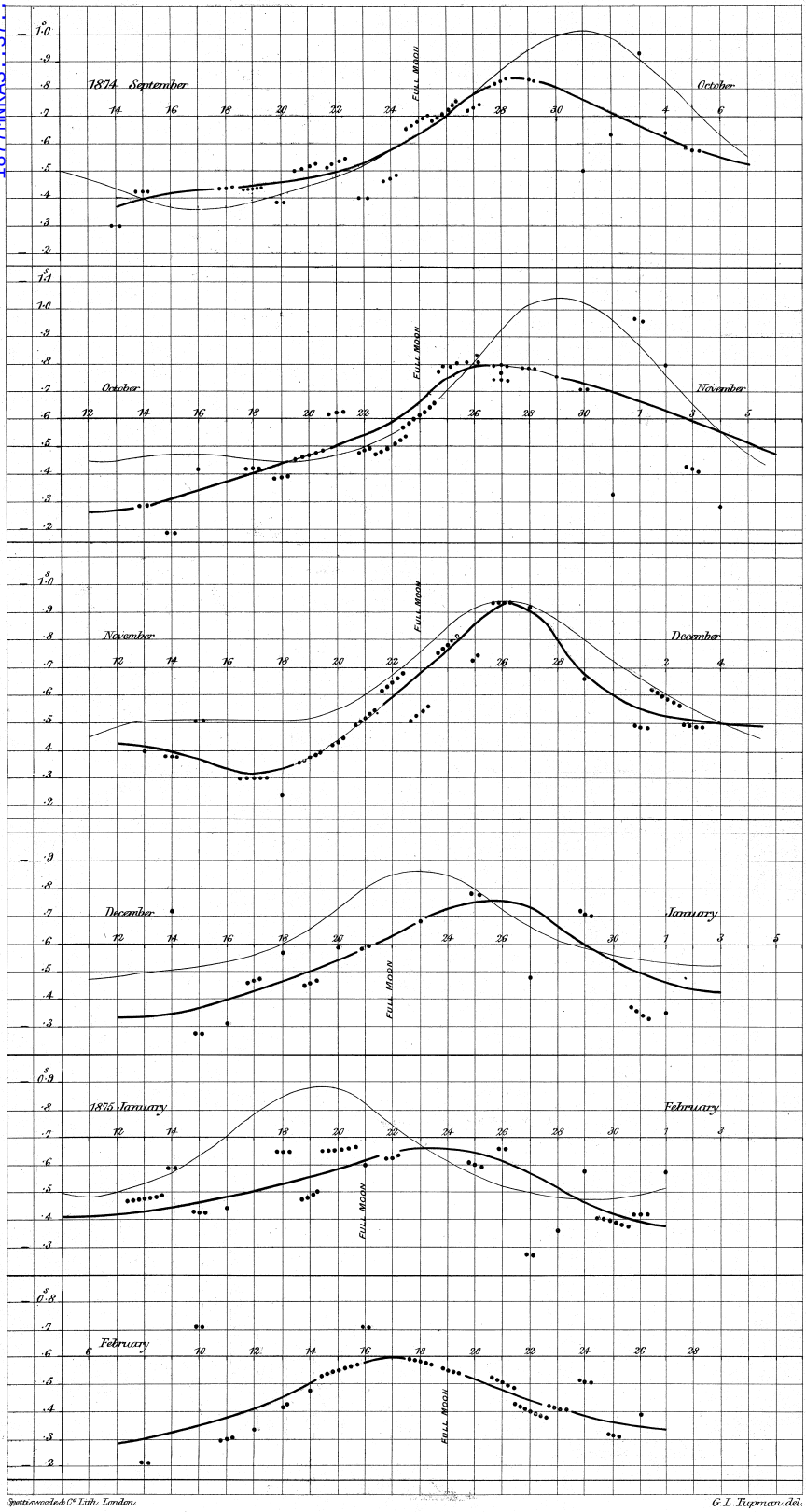
1874		Right Ascension.					North Polar Distance.			
		Greenwich Transit Circle.	Greenwich Altazimuth.	Paris.	Königsberg	Strasburg.	Greenwich Transit Circle.	Greenwich Altazimuth.	Paris.	Oxford.
		s	s	s	s	s	″	″	″	″
Oct.	4		+·01					+1·3		
,,	5		−·53	+·23				−0·9	+0·5	
,,	14			+·04						
,,	15			−·11						
,,	16				+·07					
,,	18	+·11	−·16				+0·8	−1·7		
,,	19	+·06	−·26				+1·5	+1·3		
,,	20	+·02	−·01	−·02			−1·7	−0·4	−3·4	
,,	21	+·12	+·12				+1·5	+3·7		+2·8
,,	22	−·01	−·14				+0·2	−2·1		
,,	23		−·24	·00 −·09		−·06		−2·4	−0·5	
,,	24		+·17	+·04 −·14	−·16	−·11		+0·4	−1·4 +2·6	
,,	25		−·26		−·07	−·24		−2·3	+4·2	
,,	26			+·01					+2·5	
,,	27	+·23	−·20	−·20		−·03	−1·0	−1·1	+2·1	
,,	28	+·05	−·06				−1·5	−0·9		
,,	29				·00					
,,	30		−·24		+·19			−2·4		

Oct.	31		−·37					−1·6		
Nov.	1			+·29					+1·1	
,,	2		+·17					−0·1		
,,	3		−·22	−·15				+0·7	−1·3	
,,	4		−·28					+0·9		
,,	13		−·02					−3·1		
,,	14			−·14	+·21				+1·2	+2·1
,,	15					+·14				
,,	17	+·11	−·21	−·05			+1·0	−4·0		
,,	18		−·11					−6·0		
,,	19	+·12	+·14	−·18			+1·2	+3·1	−0·9	−3·4
,,	20	+·07	−·18				−2·4	−1·1		
,,	21			(+·22 / −·22)		+·13			(+2·1 / −1·1)	
,,	22	−·16	+·14			−·08	+0·8	+2·0		
,,	23		−·16	(−·02 / −·17)				+1·9	(−3·1 / +1·8)	−2·6
,,	24		+·23	+·04		−·07		+5·1		
,,	25			−·11					+0·3	
,,	26	−·07				+·10	−5·9			
,,	27		+·01					+1·2		
,,	29		−·01					+0·3		
Dec.	1	−·01	−·18				+1·4	−0 5		

	Right Ascension.					North Polar Distance.			
	Greenwich Transit Circle.	Greenwich Altazimuth.	Paris.	Königsberg.	Strasburg.	Greenwich Transit Circle.	Greenwich Altazimuth.	Paris.	Oxford.
1874	s	s	s	s	s	″	″	″	″
Dec. 2	+·19	·00	−·02		+·06	−1·6	+2·5		
,, 3		−·20	+·07		−·05		−0·2	−0·6	
,, 14		+·36					−2·1		+0·7
,, 15			−·11						
,, 16		−·09					−0·4		+0·6
,, 17	+·07	−·08				−1·3	+2·6		
,, 18		+·09					+0·4		
,, 19	+·01	−·18				−0·4	−0·5		+2·0
,, 20		+·04					−2·5		
,, 21	·00					+1·3	−2·8		+1·1
,, 23		·00					+0·8		
,, 25	+·03					−0·5			
,, 27		−·26					+1·7		
,, 29	+·23	−·13				0·0	−1·5		
,, 31		−·21	−·16	−·11			−2·5	+1·3	
1875									
Jan. 1		+·13							
,, 13	−·05	+·26	−·17	+·17		−1·1	−0·4	+0·3	−3·9
,, 14				+·12					
,, 15	+·06	−·28				+0·1	+0·2		−0·6

Jan. 16	−·05									+ 1·5	
,, 17	−·34									0·0	
,, 18	+ ·05	+ ·22						− 1·6		+ 1·2	− 6·4
,, 19	−·14		(+ ·04 − ·09)						(+ 1·3 + 2·5)	+ 0·7	
,, 20	+ ·28	+ ·06	(+ ·04 − ·11)					− 1·6	(− 3·8 0·0)	+ 1·6	− 4·3
,, 21		−·02						− 1·6		+ 1·4	− 3·2
,, 22		+ ·14			−·09					+ 3·3	
,, 24		+ ·33								− 0·5	
,, 25		−·30			+ ·07					+ 0·6	
,, 26					+ ·04						
,, 27					−·30						
,, 28				−·17							
,, 29		+ ·10								0·0	
,, 30		+ ·03	− ·10	−·25	+ ·13			− 0·5		+ 1·5	
,, 31		−·20	+ ·14							− 0·6	
Feb. 1		+ ·19								− 6·5	
,, 8			−·09								
,, 10					+ ·37						
,, 11			− ·02	−·18							
,, 12		−·07									
,, 13				−·03							

1875	Right Ascension. Greenwich Transit Circle. s	Greenwich Altazimuth. s	Paris. s	Königsberg. s	Strasburg. s	North Polar Distance. Greenwich Transit Circle. ″	Greenwich Altazimuth. ″	Paris. ″	Oxford.
,, 14		−·02					−3·1		
,, 15	+·15	−·24	(+·03 / −·10)	+·08		−0·3	+4·0	(−1·8 / +1·2)	
,, 16		+·30		−·02			−2·4		
,, 17		−·12					+1·2		
,, 18	+·08	+·13	(+·21 / −·18)			−1·6	+1·6	(−0·3 / +0·2)	
,, 19			(−·01 / −·05)	+·11				(−0·8 / −0·1)	
,, 21	+·12	−·16			+·04	+1·0	−0·5		
,, 22	+·09	−·16	−·15		·00	−1·1	−2·4	+0·1	
,, 23		−·25		−·20	+·23		+3·0		
,, 24				−·12	+·24				
,, 25				−·15	+·07				
,, 26				+·04					



EXPLANATION OF THE ENGRAVED CURVES.

The dots represent the actual observations as weighted in the following manner:–

The observations with the Greenwich Transit Circle, at Paris, and at Strasburg, have the weight 2; those at Königsberg and with the Greenwich Altazimuth the weight 1.

The number of dots shows the weight for the day; the centre dot of each group should be on the ordinate representing the day.

The strong black line is the adopted correction, the fine line shows the correction deduced by Professor Newcomb.